

Work Order ID 142479

Wednesday, March 09, 2016 2:51:46 PM

142479

Page 1

Item ID: D3560-1

Accept

N900040100

Setup Start ***NS1***

Revision ID:

Stop ***NS2***

Item Name: Arm

Start Date: 4/23/2016 Start Qty: 4.00

4

Cust Item ID:

Required Date: 4/30/2016 Req'd Qty: 4.00

4

Customer:

Reference:

Approvals:

Process Plan: MLS

Date: MAR 10 2016 Tooling:

Date:

QC:

Date:

SPC (Y/N):

Date:

Run Start ***NR1***

Stop ***NR2***

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
--------------------------------	--------------------------	----------------------	---------	--------	--------------	---------------	---------------	------------------	----------------

Draw Nbr	Revision Nbr
D3560	Rev D

100

0.00

100

Bandsaw

BAND SAW

Memo

0.00

Jeaspa Bandsaw

Cut blanks 16.750" long

110

0.01

110

HAAS 1

HAAS CNC VERTICAL MACHINING #1

Memo

0.03

HAAS CNC vertical machine #1

1- Mill as per Folio FA693 Rev: AA & Dwg D3560 Rev: D
2-C'sink 0.196" hole on manual mill as per dwg D3560 J.C.L. 10-04-18
3-Deburr per dwg D3560

120

0.00

120

QC

QC2- Inspect parts off machine FAI/FAIB

Memo

0.00

Quality Control

PTO =>

DQA:

Date: 16.05.16



WORK ORDER NON-CONFORMANCE / UPDATE

QA Closed: ~~RAW~~

Date: 16/05/10

Work Order update only ☐

Work Order: <u>142479</u> Part No. <u>D3560-1</u> NCR No. <u>16-5772</u>		DISPOSITION Rework ☐ Scrap ☐ Use-as-is ☒ Suspected Unapproved ☐		AGAINST DEPARTMENT/PROCESS Skid-tube ☐ Cross tube ☐ Water Jet ☐ Engineering ☐ Machining ☐ Small Fab ☐ Prod. Eng. Coord. ☐ Quality ☒ Thermoforming ☐ Finishing ☐ Rec/Store/Packaging ☐ Other ☐ Large Fab ☐ Composite ☐ Supplier ☐			
Date: 16/04/19		Step #: 130		QTY Effective: 3		MRB (QSI042) Approval DAS 12 16/4/19	
Description Work Order Deviation				Disposition			
Found at Qc8 inspection that the stock material (raw material) is undersized by .005" on 3 parts (.485") P.C. material.				Acceptable. Margin of safety still positive per SR-P577-1, ref attached.			
				Completed By DAS D.A. 16/04/19			
				Lead hand / Supervisor Approval Verification DAS 9 16-04-20			
				QC / QA Coordinator Approval DAS 9 16-04-20			
Root Cause Environment ☐ No Re-verification ☐ Design ☐ Operator ☐ Doc/Data ☐ Offset/Setup ☐ Equip/Tooling ☐ Supplier ☐ Handling/Pre ☐ Training ☐ Material ☒ Use for Testing ☐ Internal Transport ☐ Poor Information ☐ Tribal Knowledge ☐ Rushing ☐ LOA ☐ Product Improvement ☐ Substation ☐ Process Improvement ☐ Past Expiry Date ☐ Manufacturing Process ☐ Misidentified ☐ Past Due ☐		Pressure/Forced ☐ Bending ☐ Centre Not Concentric ☐ Cracks ☐ Crimp/Kink/Ripple/Wave ☐ Cuffs ☐ Crushing ☐ Heat Treat ☐ Wave/Twist in Tube ☐ Marks/Chatter ☐		FAULT CATEGORY Temperature/Cure ☐ Set-up ☐ BOM/Route ☐ Broken/Damage/Defect ☐ Inspection Incomplete/Unqualified ☐ Contamination ☐ Countersink ☐ Cut Too Short ☐ Instructions Incomplete/Unclear ☐ Drill Holes ☐		Power Loss/Surge ☐ Folio/Program ☐ Grain ☐ Weld ☐ Wrong Stock Pulled ☐ Out of Sequence ☐ Off-set ☐ Misabeled ☐ Fit/Function ☐ Misaligned/off center ☐	
		Positioned Wrong ☐ Outside Dimensions ☐ ☒ Over/Under tolerance Part Incorrect ☐ Part Lost/Missing ☐ Part Moved ☐ Drawing ☐ Finish ☐ Misread ☐ Turning Sequence ☐					
		OTHER: ☐					

Work Order ID 142479

Wednesday, March 09, 2016 2:51:46 PM

142479

Page 2

Item ID: D3560-1 Accept ***N900040100*** Setup Start ***NS1***
Revision ID: Stop ***NS2***
Item Name: Arm
Start Date: 4/23/2016 Start Qty: 4.00 ***4*** Cust Item ID:
Required Date: 4/30/2016 Req'd Qty: 4.00 ***4*** Customer:
Reference:

Approvals: Process Plan: _____ Date: _____ Tooling: _____ Date: _____ Run Start ***NR1***
QC: _____ Date: _____ SPC (Y/N): _____ Date: _____ Stop ***NR2***

Sequence ID/ Work Center ID	Operation Description	Set Up/ Run Hours	Tool ID	Tool #	Plan Code	Accept Qty	Reject Qty	Reject Number	Insp. Stamp
130 *130* QC Quality Control	QC8- Inspect parts - second check Memo	0.00 0.00		16/04/20		4	0		DAS 08 9-89
210 *210* Packaging Packaging	Identify as per dwg & Stock Location: <u>WA3</u> Memo LOCATION: WA003	0.00 0.00				4		16.4.26	PC
220 *220* QC Quality Control	QC21- Final Inspection - Work Order Release Memo	0.00 0.01							MUS APR 26 2016

MUS APR 26 2016

DQA: _____ Date: _____



WORK ORDER NON-CONFORMANCE / UPDATE

QA Closed: _____ Date: _____

Work Order update only ☐

Work Order: _____ Part No. _____ NCR No. _____		DISPOSITION Rework ☐ Scrap ☐ Use-as-is ☐ Suspected Unapproved ☐		AGAINST DEPARTMENT/PROCESS Skid-tube ☐ Machining ☐ Thermoforming ☐ Large Fab ☐ Cross tube ☐ Small Fab ☐ Finishing ☐ Composite ☐ Water Jet ☐ Prod. Eng. Coord. ☐ Rec/Store/Packaging ☐ Supplier ☐ Engineering ☐ Quality ☐ Other ☐					
Date :		Step #:		QTY Effective :			MRB (QSI042) Approval Completed By Lead hand / Supervisor Approval Verification QC / QA Coordinator Approval		
Description Work Order Deviation				Disposition					
Root Cause		FAULT CATEGORY							
Environment ☐	No Re-verification ☐	Pressure/Forced ☐	Temperature/Cure ☐	Power Loss/Surge ☐	Positioned Wrong ☐				
Design ☐	Operator ☐	Bending ☐	Set-up ☐	Folio/Program ☐	Outside Dimensions ☐				
Doc/Data ☐	Offset/Setup ☐	Centre Not Concentric ☐	BOM/Route ☐	Grain ☐	Over/Under tolerance ☐				
Equip/Tooling ☐	Supplier ☐	Cracks ☐	Broken/Damage/Defect ☐	Weld ☐	Part Incorrect ☐				
Handling/Pre ☐	Training ☐	Crimp/Kink/Ripple/Wave ☐	Inspection Incomplete/Unqualified ☐	Wrong Stock Pulled ☐	Part Lost/Missing ☐				
Material ☐	Use for Testing ☐	Cuffs ☐	Contamination ☐	Out of Sequence ☐	Part Moved ☐				
Internal Transport ☐	Poor Information ☐	Crushing ☐	Countersink ☐	Off-set ☐	Drawing ☐				
Tribal Knowledge ☐	Rushing ☐	Heat Treat ☐	Cut Too Short ☐	Mislabeled ☐	Finish ☐				
LOA ☐	Product Improvement ☐	Wave/Twist in Tube ☐	Instructions Incomplete/Unclear ☐	Fit/Function ☐	Misread ☐				
Substation ☐	Process Improvement ☐	Marks/Chatter ☐	Drill Holes ☐	Misaligned/off center ☐	Turning Sequence ☐				
Past Expiry Date ☐	Manufacturing Process ☐	OTHER : _____							
Misidentified ☐	Past Due ☐								

Picklist Print

Wednesday, March 09, 2016 2:51:46 PM

Page 1

Work Order ID: 142479

142479

Parent Item: D3560-1

D3560-1

Parent Item Name: Arm

Start Date: 4/23/2016

Required Date: 4/30/2016

Start Qty: 4.00

Required Qty: 4.00

Comments: IPP REV:A 13.06.03 PER DWG REV.D DD VERF:JLM

Component Item ID/ Item Name	Replacement Item ID	Mfg/ Purch	Bin Item	Primary Location	Last Location	Route Seq ID	Unit of Measure	Qty on Hand	Qty per Kit	Total Qty	Qty Issued	Date Issued	Status
M6061T6B0.500X05.00 0		Purchased		No			f	33.1380		5.873684			

M6061T6B0 500X05 000

6061-T6 Bar .500 x 5.00

16/04/12

Location

Loc Qty

Loc Code

MAT001

33.138

m130527

15.991

m131392

5.147

m132835

12

1,666'
4,2'

DART AEROSPACE LTD		Work Order:	142479
Description: Arm		Part Number:	D3560-1
Inspection Dwg: D3560 Rev: D		Page 1 of 1	

FIRST ARTICLE INSPECTION CHECKLIST

☒ First Article ☐ Prototype

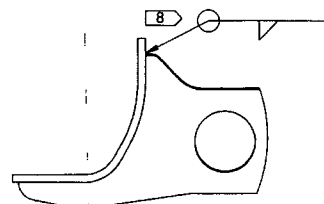
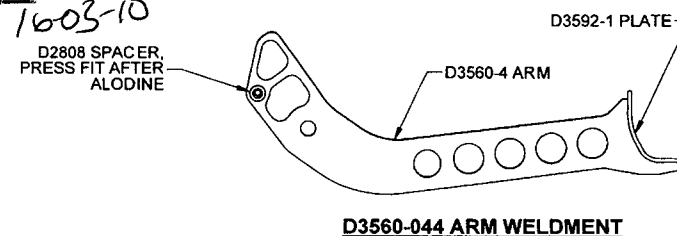
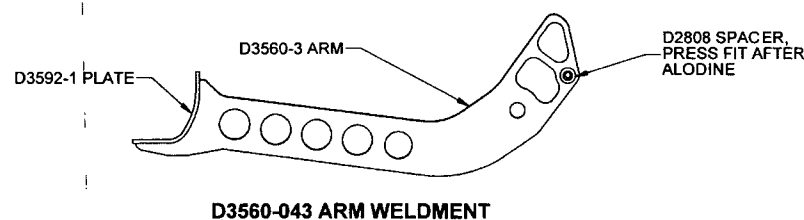
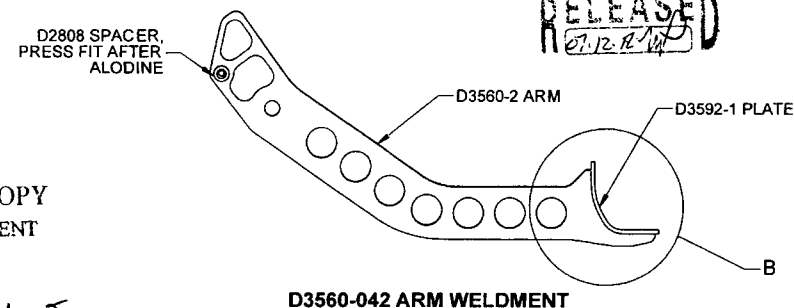
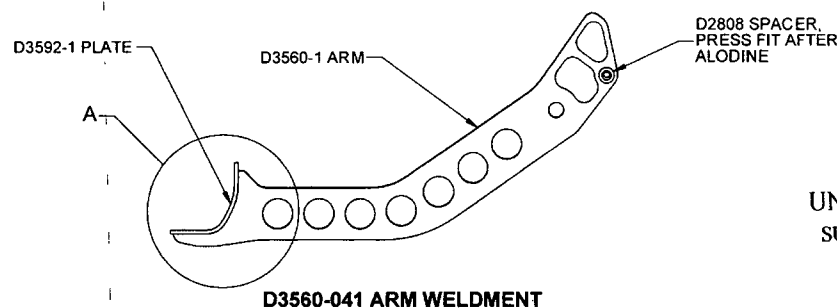
Drawing Dimension	Tolerance	Actual Dimension	Accept	Reject	Method of Inspection	Comments
Ø0.507	+0.000/-0.001	0.506	✓		—	thought gauge pin
Ø0.196	+0.005/-0.001	0.197	✓		MIP-04	vern
Ø1.000	+0.010/-0.001	1.004	✓			
0.500	+/-0.010	0.508	✓			
0.250	+/-0.010	0.247	✓			
0.275	+/-0.010	0.273	✓			
0.188	+/-0.010	0.195	✓			
2.000	+/-0.010	2.000	✓			
1.700	+/-0.010	1.700	✓			
Ø0.385 x 100°	+/-0.010 x 0.5°	0.385	✓		Caliper	JLL-08
0.250 Deep	+/-0.010	0.252	✓		MIP-08	Dial depth Mic

Measured by: <i>[Signature]</i>	Audited by: <i>[Signature]</i>	Prototype Approval:	N/A
Date: 16/04/20	Date: 16/04/20	Date:	N/A

Rev	Date	Change	Revised by	Approved
A	07.01.17	New Issue P/O D3560-041	KJ/JLM	
B	07.06.13	Dimensions updated per Dwg Rev B	KJ/JLM	
C	08.07.24	Dwg Rev updated	KJ/DD	<i>[Signature]</i>

RELEASED
07.12.16

SHOP COPY
RETURN TO
ENGINEERING
UNCONTROLLED COPY
SUBJECT TO AMENDMENT
WITHOUT NOTICE
WORK ORDER
NO. 14248 MJS
1603-10



DETAIL A
SCALE 1:2

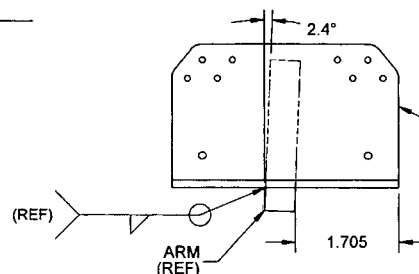
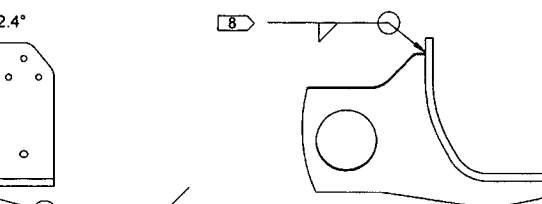
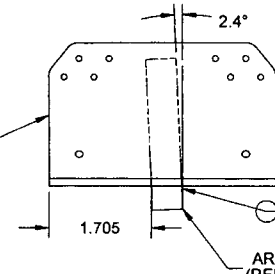


PLATE
(REF)



DETAIL B
SCALE 1:2

PARTS LIST

QTY -041	QTY -042	QTY -043	QTY -044	P/N	DESCRIPTION
X				D3560-041	ARM WELDMENT
	X			D3560-042	ARM WELDMENT
		X		D3560-043	ARM WELDMENT
			X	D3560-044	ARM WELDMENT
1	1	1	1	D2808	SPACER
1				D3560-1	ARM
	1			D3560-2	ARM
		1		D3560-3	ARM
			1	D3560-4	ARM
1	1	1	1	D3592-1	PLATE

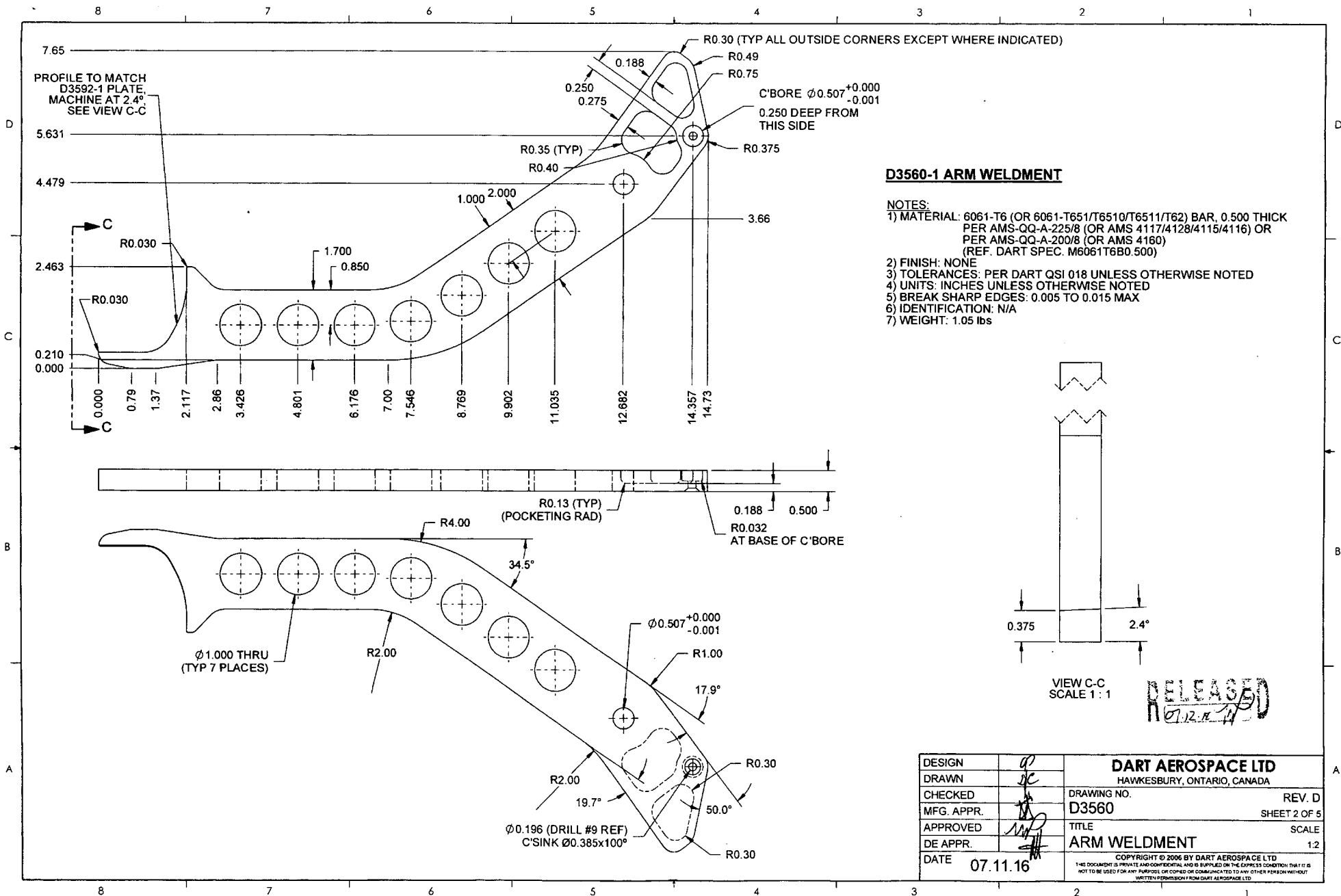
- NOTES:
- 1) MATERIAL: N/A
 - 2) FINISH: CHEMICAL CONVERSION COAT PER DART QSI 005 4.1
 - 3) TOLERANCES: PER DART QSI 018 UNLESS OTHERWISE NOTED
 - 4) UNITS: INCHES UNLESS OTHERWISE NOTED
 - 5) BREAK SHARP EDGES: 0.005 TO 0.015 MAX
 - 6) IDENTIFICATION: N/A
 - 7) WEIGHT: 1.23 lbs (TYP)
 - 8) WELDING: PER DART QSI 004

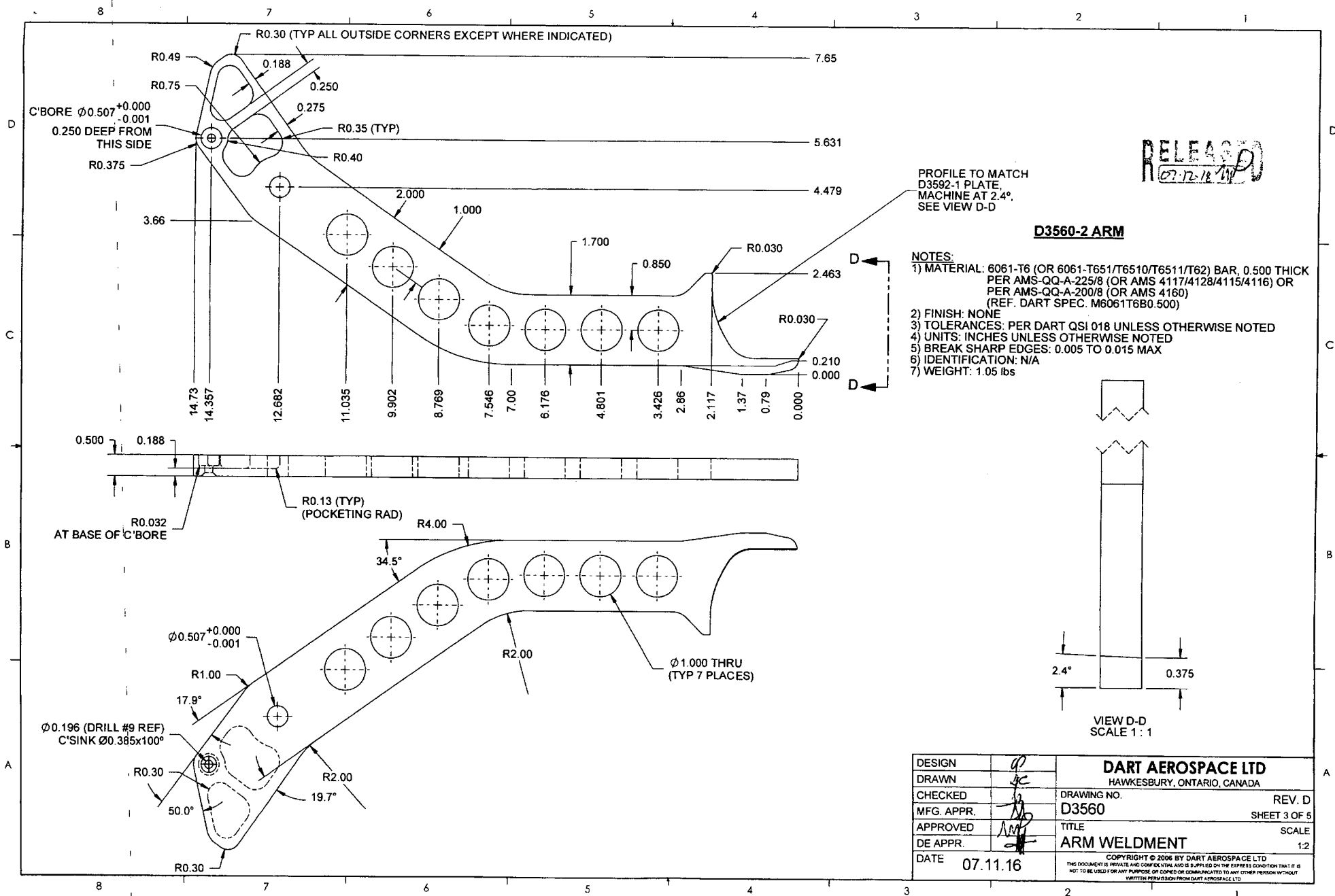
DESIGN	ADD D2808 PRESS FIT NOTE; REDRAWN IN SOLIDWORKS	DC	07.11.16
DRAWN	REMOVE POWDER COAT	CP	07.06.19
CHECKED	REDESIGN AS WELDMENT, ADD POCKETS	CP	07.01.15
MFG. APPR.	NEW ISSUE	CP	06.09.25
APPROVED		BY	DATE
DE APPR.			
DATE	07.11.16		

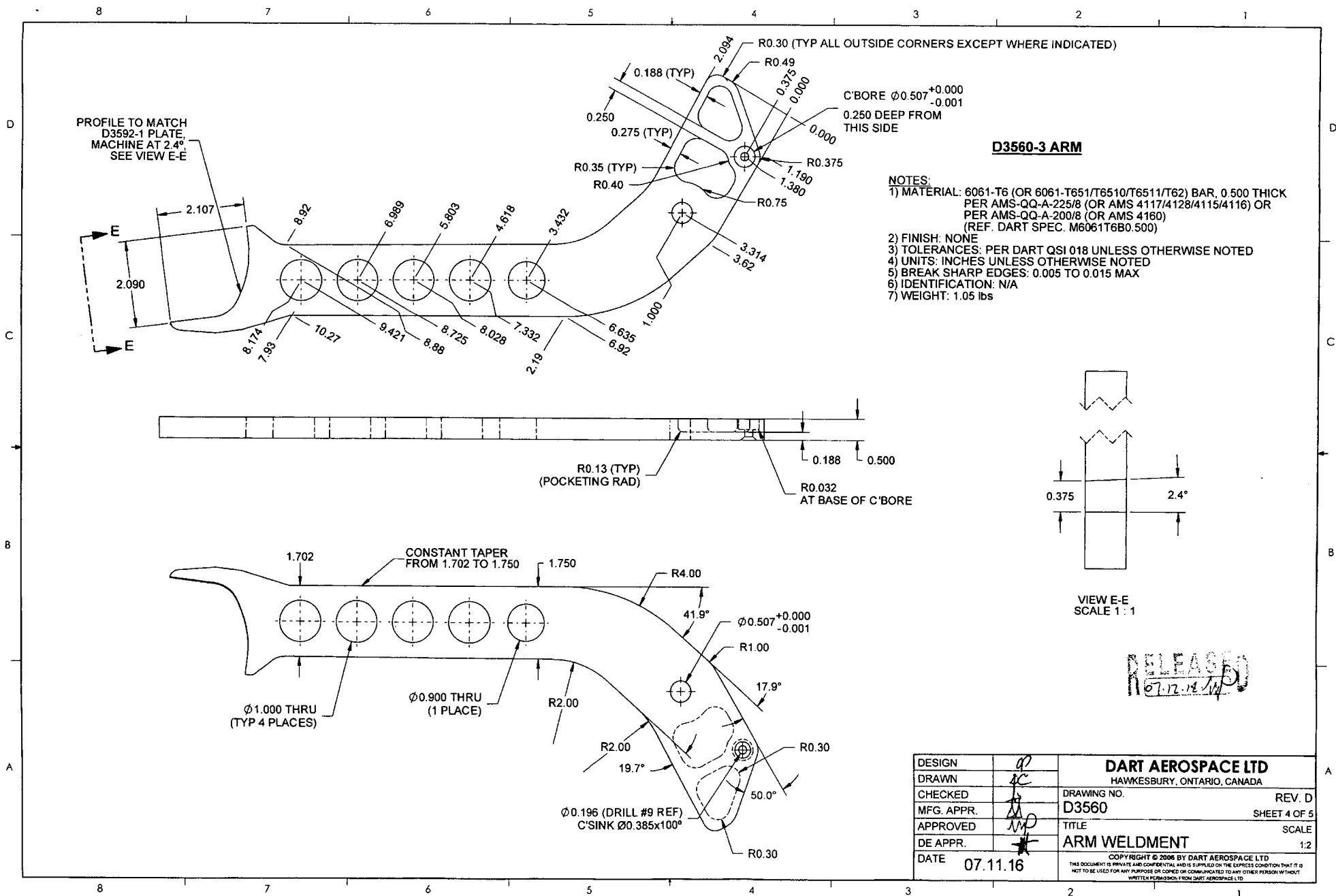
DART AEROSPACE LTD
HAWKESBURY, ONTARIO, CANADA

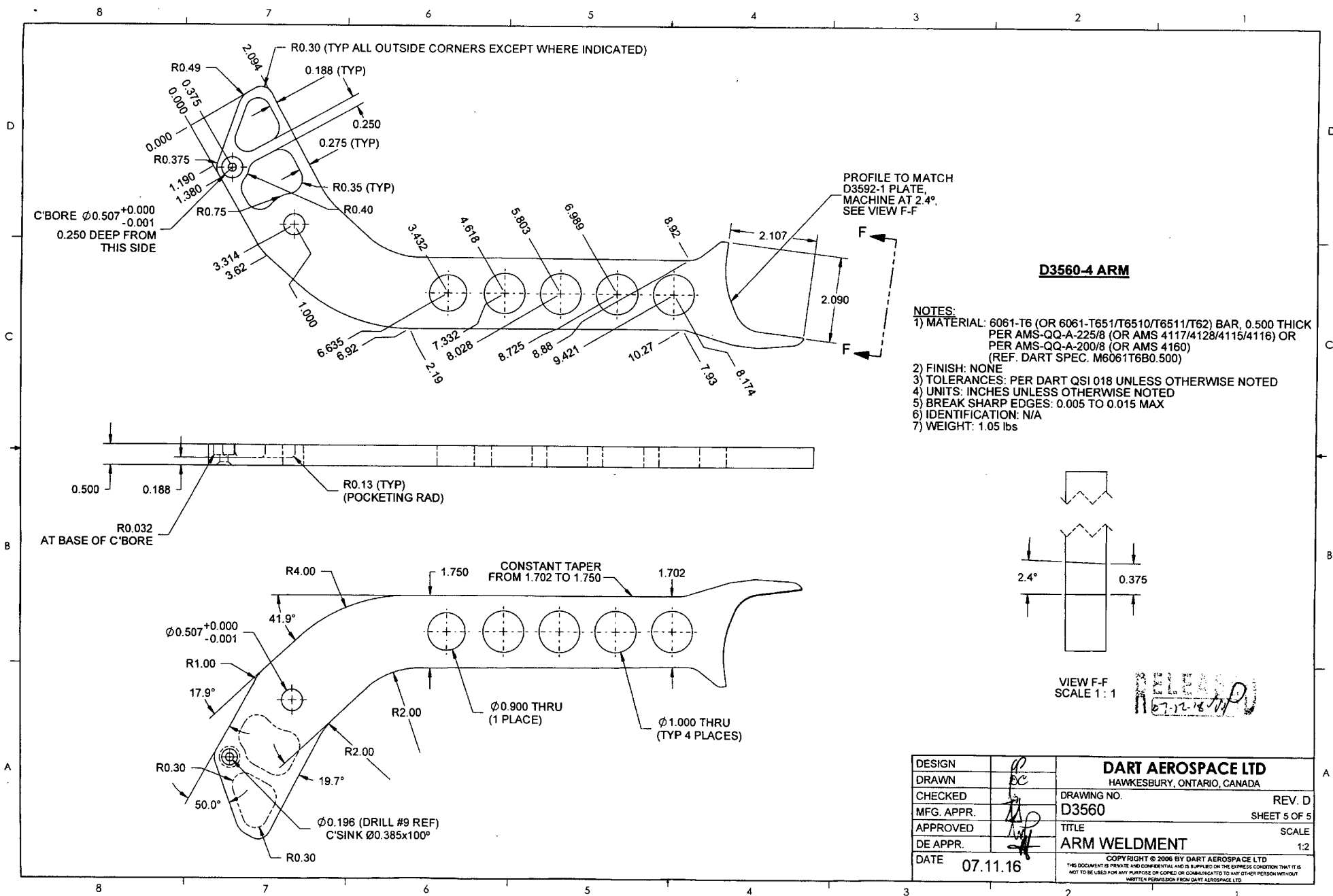
DRAWING NO. D3560
REV. D
SHEET 1 OF 5
TITLE
ARM WELDMENT
SCALE
1:4

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DESIGN		DART AEROSPACE LTD	
DRAWN	EC	HAWKESBURY, ONTARIO, CANADA	
CHECKED		DRAWING NO. D3560	REV. D
MFG. APPR.		SHEET 5 OF 5	
APPROVED		TITLE ARM WELDMENT	SCALE 1:2
DE APPR.		COPYRIGHT © 2006 BY DART AEROSPACE LTD	
DATE	07.11.16	THIS DOCUMENT IS PRIVATE AND CONFIDENTIAL AND IS SUPPLIED ON THE EXPRESS CONDITION THAT IT IS NOT TO BE USED FOR ANY PURPOSE OR COPIED OR COMMUNICATED TO ANY OTHER PERSON WITHOUT WRITTEN PERMISSION FROM DART AEROSPACE LTD.	

6.2 D3387-1/-2 ARM

The D3387-1/-2 arms are used in the D412-630-023/-024 steps. The maximum load in this part corresponds to R84L = R155L determined in section 4.1 of this report. Refer to Figure 6 in Appendix D for the geometry involved in this analysis. For each critical section shown in Figure 6, the D3387-1/-2 arms are checked for bending failure.

Geometry

$$\begin{array}{lll} x1 := 12.19 \cdot \text{in} & x_a := 11.64 \cdot \text{in} & \theta_a := 35.77 \cdot \text{deg} \\ x2 := 1.99 \cdot \text{in} & x_b := 0.95 \cdot \text{in} & \\ & x_c := 0.60 \cdot \text{in} & \\ & x_d := 6.21 \cdot \text{in} & \end{array}$$

Loads

$$\begin{array}{lll} F := R84L & F = 765 \cdot \text{mass} & \text{Applied load} \\ M_{\max} := F \cdot x1 & M_{\max} = 9325 \cdot \text{lb} \cdot \text{in} & \text{Maximum bending moment} \\ F_s := \frac{M_{\max}}{x2} & F_s = 4686 \cdot \text{mass} & \text{Load applied to the stop} \\ F_{py} := F + F_s \cdot \sin(\theta_a) & F_{py} = 3504 \cdot \text{mass} & \text{Vertical load at the pivot} \\ F_{px} := F_s \cdot \cos(\theta_a) & F_{px} = 3802 \cdot \text{mass} & \text{Horizontal load at the pivot} \\ F_p := \sqrt{F_{py}^2 + F_{px}^2} & F_p = 5171 \cdot \text{mass} & \text{Total pivot load} \end{array}$$

Section A-A Analysis

$$\begin{array}{lll} H := 2.00 \cdot \text{in} \quad t := 0.125 \cdot \text{in} \quad w := 0.485 \cdot \text{in} \quad h := 0.300 \cdot \text{in} & & \text{Section A-A parameters} \\ I := \frac{t \cdot H^3}{12} + 2 \cdot \left[\frac{(w-t) \cdot h^3}{12} + (w-t) \cdot h \cdot \left(\frac{H}{2} - \frac{h}{2} \right)^2 \right] & I = 0.241 \cdot \text{in}^4 & \text{Inertia at Section A-A} \\ M_a := \frac{x_a}{x1} \cdot M_{\max} & M_a = 8905 \cdot \text{lb} \cdot \text{in} & \text{Moment at Section A-A} \\ \sigma_a := \frac{M_a \cdot H}{2 \cdot I} & \sigma_a = 36947 \cdot \text{psi} & \text{Stress at Section A-A} \\ MS23a := \frac{F_{tu}}{\sigma_a} - 1 & MS23a = 0.03 & \text{Margin of Safety at Section A-A} \end{array}$$

Section B-B Analysis

$$\begin{array}{lll} H := 1.744 \cdot \text{in} \quad t := 0.125 \cdot \text{in} \quad w := 0.485 \cdot \text{in} \quad h := 0.25 \cdot \text{in} & & \text{Section B-B parameters} \\ I := \frac{t \cdot H^3}{12} + 2 \cdot \left[\frac{(w-t) \cdot h^3}{12} + (w-t) \cdot h \cdot \left(\frac{H}{2} - \frac{h}{2} \right)^2 \right] & I = 0.157 \cdot \text{in}^4 & \text{Inertia at Section B-B} \\ M_b := \frac{x_b}{x2} \cdot M_{\max} & M_b = 4452 \cdot \text{lb} \cdot \text{in} & \text{Moment at Section B-B} \\ \sigma_b := \frac{M_b \cdot H}{2 \cdot I} & \sigma_b = 24784 \cdot \text{psi} & \text{Stress at Section B-B} \\ MS23b := \frac{F_{cy}}{\sigma_b} - 1 & MS23b = 0.372 & \text{Margin of Safety at Section B-B} \end{array}$$

Section C-C Analysis

$$H := 0.50 \cdot \text{in} \quad w := 0.485 \cdot \text{in}$$

$$I := \frac{1}{12} \cdot w \cdot H^3 \quad I = 0.005 \cdot \text{in}^4$$

$$M_c := \frac{x_c}{x_l} \cdot M_{\max} \quad M_c = 459 \cdot \text{lb} \cdot \text{in}$$

$$\sigma_c := \frac{M_c \cdot H}{2 \cdot I} \quad \sigma_c = 22713.402 \cdot \text{psi}$$

$$MS_{23c} := \frac{F_{cy}}{\sigma_c} - 1 \quad MS_{23c} = 0.497$$

Section C-C parameters

Inertia at Section C-C

Moment at Section C-C

Stress at Section C-C

Margin of Safety at Section C-C

Section D-D Analysis

$$H := 1.700 \cdot \text{in} \quad t := 0.125 \cdot \text{in} \quad w := 0.485 \cdot \text{in} \quad h := 0.188 \cdot \text{in}$$

$$I := \frac{t \cdot H^3}{12} + 2 \cdot \left[\frac{(w - t) \cdot h^3}{12} + (w - t) \cdot h \cdot \left(\frac{H}{2} - \frac{h}{2} \right)^2 \right] \quad I = 0.129 \cdot \text{in}^4$$

$$M_d := \frac{x_d}{x_l} \cdot M_{\max} \quad M_d = 4751 \cdot \text{lb} \cdot \text{in}$$

$$\sigma_d := \frac{M_d \cdot H}{2 \cdot I} \quad \sigma_d = 31318 \cdot \text{psi}$$

$$MS_{23d} := \frac{F_{cy}}{\sigma_d} - 1 \quad MS_{23d} = 0.086$$

Section D-D parameters

Inertia at Section D-D

Moment at Section D-D

Stress at Section D-D

Margin of Safety at Section D-D

Section P-P Analysis

$$H := 2.00 \cdot \text{in} \quad w := 0.485 \cdot \text{in}$$

$$I := \frac{1}{12} \cdot w \cdot H^3 - \frac{1}{12} \cdot 0.5 \cdot \text{in} \cdot (0.507 \cdot \text{in})^3 \quad I = 0.318 \cdot \text{in}^4$$

$$M_p := M_{\max} \quad M_p = 9325 \cdot \text{lb} \cdot \text{in}$$

$$\sigma_p := \frac{M_p \cdot H}{2 \cdot I} \quad \sigma_p = 29334 \cdot \text{psi}$$

$$MS_{23p} := \frac{F_{cy}}{\sigma_p} - 1 \quad MS_{23p} = 0.159$$

Section P-P parameters

Inertia at Section P-P (section has 0.507" diam hole)

Moment at Section P-P

Stress at Section P-P

Margin of Safety at Section P-P

DAS
12
589

16/4/20